

New Salt Tolerant Rice Variety: Hope for the Coastal Farmers

In Bangladesh 1 million hectare of rice lands are currently affected by salinity and further degradation will have detrimental consequences on food security due to limited land resources. About 53% of the coastal areas are affected by salinity. Agricultural land use in these areas is very poor, which is much lower than country's average cropping intensity. Salinity causes unfavorable environment and hydrological situation that restrict the normal crop production throughout the year. The dominant crop grown in the saline areas is local transplanted Aman (wet season) rice crop with low yields. It has become imperative to explore the possibilities of increasing potential of these (saline) lands for increased production of crops.

Thus, it is necessary to have an appraisal of the present state of land areas affected by salinity. Use of salt-tolerant varieties is considered the most economical and most effective way of increasing crop production on saline soils. Attempts to improve the salt tolerance of crops through conventional breeding programmes have met with very limited success; due to the complexity of the trait-salt tolerance is complex genetically and physiologically. Salt tolerance is a quantitative trait, which is affected by environmental variation. The classical method cannot detect a single gene locus associated with quantitative traits, their locations on chromosomes, or their relationship with other genes.



Salt affected fallow land due to salinity intrusion in cultivable land

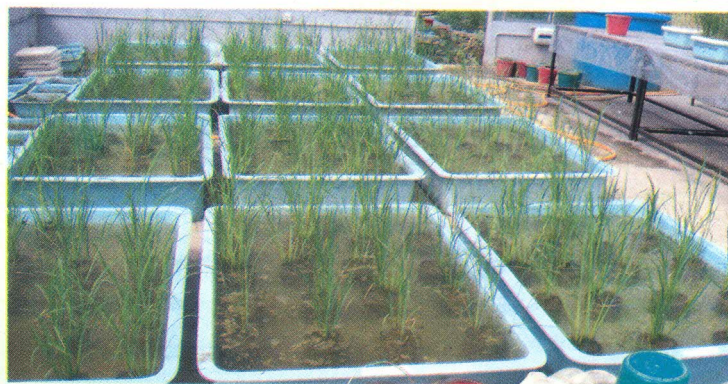
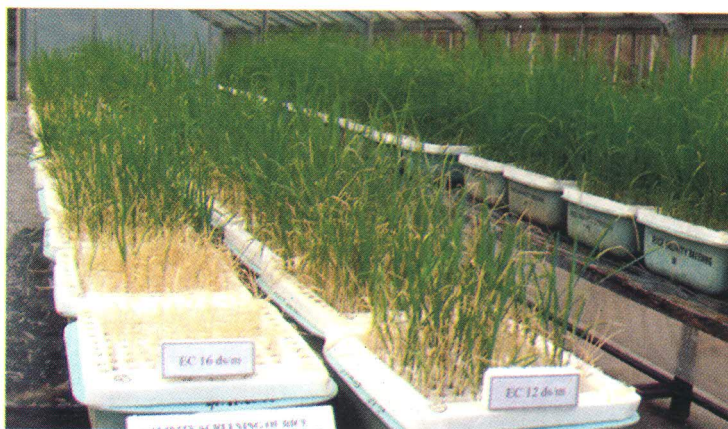


Thus, selection for salinity tolerant genotypes of rice based on phenotypic merits alone is less reliable and will delay progress in breeding. Marker technology can facilitate and speed the development of salt tolerant varieties. Biotechnology along with the use of nuclear techniques will provide a greater opportunity to the scientists of BINA for the development of cost-effective and eco-friendly technology for improving salt tolerant rice variety with acceptable yield and increasing crop production in the country.

Against the backdrop, PIU-BARC finance a sub project titled "Development of salt tolerant rice varieties through induced mutation and marker-assisted selection" with the goal to develop salt tolerant rice varieties through induced mutation and biotechnological approach (marker-assisted selection) as well to enhance rice production for food security and improve livelihood of farm community.

Approach and Methodology:

Selected 60 rice germplasm were evaluated for salinity tolerance in hydroponic system at the seedling stage using IRRI standard protocol. Out of 60 rice germplasm, 24 were selected based on salt tolerance. At the seedling stage screening, 9 lines were found tolerant at EC level 12 dS/m, while, 15 lines were moderately tolerant. Selected 24 germplasm were screened for salinity tolerance in sustained water bath at the reproductive stage using IRRI standard protocol. Two strains viz., Pokkali and INGER IRRI line, PBRC-37 (pedigree: IR64197-3B-14-2, parentage: IR42598-B-B-B-12/NONA BOKRA, proposed salt tolerant variety, Binadhan-10) were found as salt tolerant, 4 lines as moderately tolerant among 24 tested entries at EC level 6-12 dS/m.



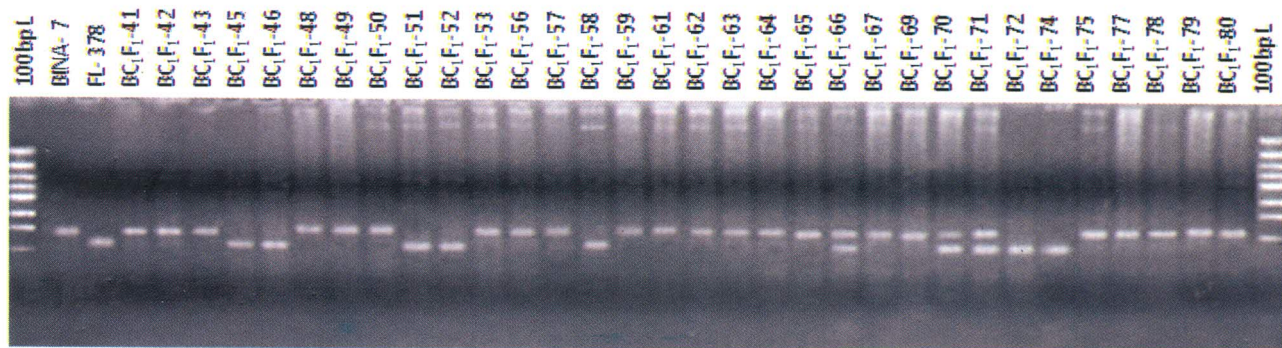
Screening of rice germplasm at seedling stage using hydroponic system (EC 12 dS/m) and reproductive stage (EC 6 dS/m) using sustained water bath grown at BINA glasshouse

Induced Mutation:

Three salt tolerant rice genotypes (viz., Pokkali, FL-378 and FL-478) were irradiated with gamma-rays and 68 M_2 plants of FL-378 and 54 M_2 plants of FL-478 have been selected which are now being tested for salt tolerance.

Introgression of Salt Tolerant Genes into Popular Rice Varieties:

Two salt tolerant rice genotypes (FL-378 and FL-478) were crossed with high yielding/short duration popular varieties (Binadhan-5 and Binadhan-7). A total of 85 BC_2F_1 population of Binadhan-7 \times FL-378 and 125 BC_2F_1 of Binadhan-7 \times FL-478 have been genotyped using SSR markers for confirmation of introgressed salt tolerant genes.



Banding pattern of BC₂F₁ of Binadhan-7×FL378 using SSR markers

Field Evaluation

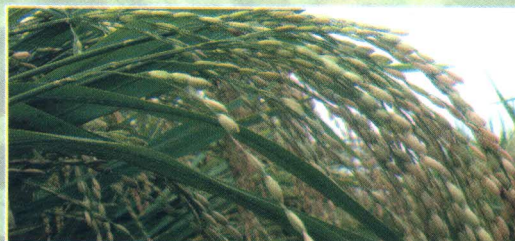
Evaluation of PBRC-37 (proposed salt tolerant variety, Binadhan-10) was done in Boro season of 2011-2012 in the coastal saline areas of Satkhira, Bagerhat and Khulna. The line gave higher yield (5.6 t/ha) under salt stress (10-12 dS/m) than the released salt tolerant variety Binadhan-8. The evaluation was done by the Seed Certification Agency (SCA). The Technical Committee of National Seed Board has already approved this line as salt tolerant rice variety named Binadhan-10.



Evaluation trial of proposed salt tolerant variety Binadhan-10 (PBRC-37) saline areas (Tikabunia, Dumuria, Khulna) grown in Boro (dry) season, 2011-12.

Technology Generation

- Phenotypic screening protocol for salinity tolerance of rice at seedling and reproductive stages has been established.
- Study for marker-assisted selection (MAS) has been initiated.
- Promising salt tolerant line PBRC-37 (Binadhan-10) has been found with of salt tolerance EC 10-12 dS/m, maturity period of 127-132 days and higher yield between 5-6 t/ha under salt stress than released salt tolerant variety Binadhan-8.



Achievement

The new salt tolerant rice variety (Binadhan-10) can tolerate up to 12 dS/m of salinity which can be cultivated in 40-50% of those fallow lands in both Boro (dry season) and Aman (wet season) seasons. The farmers can get yield of 5.5-6.5 t/ha in saline land and 7.5-8.5 t/h in non-saline lands using this variety. The variety possess deep green and erect flag leaves, trunks and stems are strong, sturdy and remain erect (no lodging) even in stormy weather. Disease and pest attacks are very low and the production cost is same as the other varieties. Binadhan-10 can be cultivated in a large part of saline prone areas of 13 coastal districts and more 4-5 million tons of additional rice can be produced a year. If the Government and private agencies could extend this variety in a large scale on lands having salinity up to 12 dS/m, it would enable the farmers as well as the country to have higher productivity, ensure food security and improve livelihood of the coastal farming community.

Economics of Binadhan-10 cultivation in Boro (dry) season in the salt affected lands:

Parameters	Local/HYV (salt susceptible variety)	Binadhan-10 (salt tolerant variety)
Income Per hectare (Taka)	5,000/-	50,000/-

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